

Catheter Related Infections

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Catheter Related Infections



➤ Agenda

- Introduction
- Definitions
- Diagnosis
- Complications
- Treatment
- Conclusion

Catheter related infections

- The most important catheter related complications which determine catheter survival are infection and dysfunction.
- Infectious episodes are the leading cause for catheter removal and catheter related morbidity in dialysis patients.

Prospective study of 526 incident patients starting RRT. 1 year follow up. Univariate analysis:

- The most common single reason for admission was creation of & complications to vascular access for HD.
- The use of temporary vascular access for HD were associated with prolonged hospitalisation & repeated admissions.

Metcalf Et Al. Q J Med 2003; 96: 899

Septicemia, access and cardiovascular disease in dialysis patients

- First cause of Morbidity.
- Second cause of mortality

shani A, Collins AJ, Herzog CA, Foley RN: Kidney Int 68: 311–318, 2005

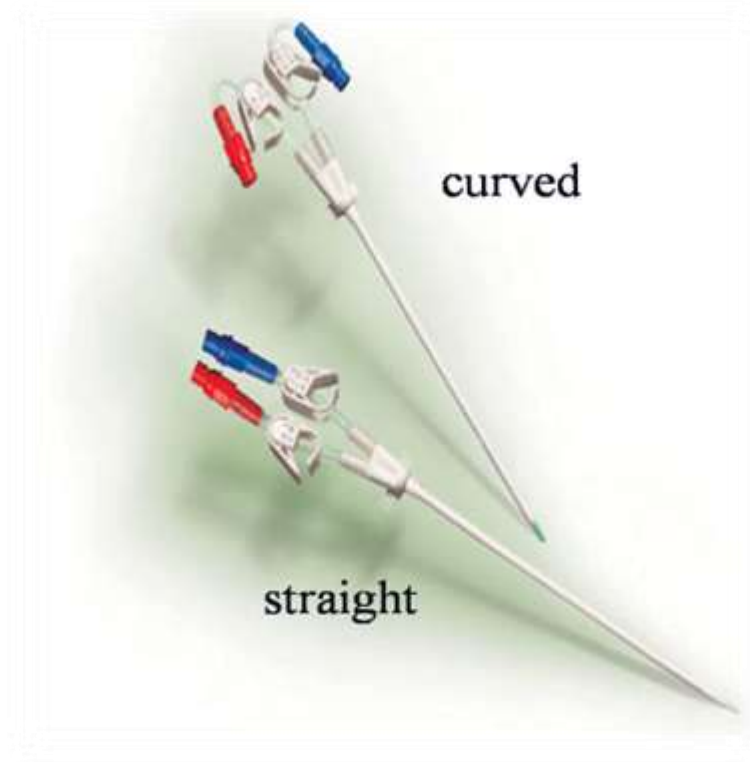
Indication of catheter

- Acute Kidney Injury .
- ESRD with no access.
- ESRD with failure of access.
- Peritoneal dialysis with complications.
- Transplant patients require HD.
- Plasmapheresis and Hemoperfusion.
- Dialysis for overdose.

Types of catheters

Temporary non Cuffed Catheters

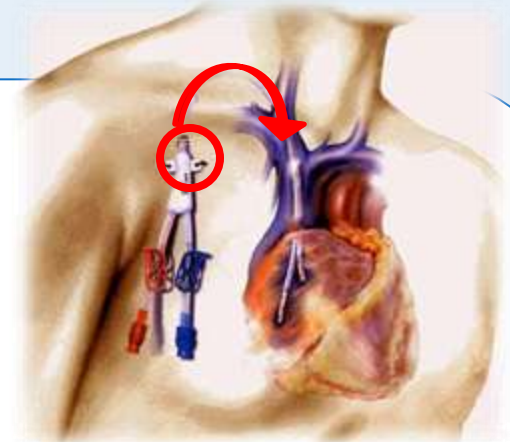
- Short.
- More ridged.
- Easy and fast insertion.
- Immediate use.
- Higher infection rate.
- Preferred IJ or femoral.
- Avoid subclavian.
- < 3wks for IJ.
- <5 days for femoral.



Types of catheters

Cuffed Tunneled Catheters

- Dacron cuff.
- Softer.
- Sheath for insertion.
- Different holes, length and material.
- Requires sedation.
- Lower neck insertion site.
- More bleeding.
- **1 year –Indefinite.**



Pathogenesis

- It has been shown that almost all indwelling vascular catheters are colonized by microorganisms
- These micro organisms are imbedded in a biofilm layer and can be present 24h after insertion .
- There is a link between the number of organisms retrieved by culture from the catheter surface and the risk of infection associated with these catheters
- Infection depend on whether the organism on the catheter surface exceed a certain quantitative threshold.

Source of infections

1. Organisms causing bloodstream infections enter the bloodstream from the skin insertion site or through the hub of the catheter.
2. Skin organisms migrate from the skin insertion site along the external surface of the catheter colonizing the distal intravascular tip.
3. The subsequent colonization of the internal surface of catheter cause blood stream infection.
4. Organisms may be introduced into the hub of catheter by hands of medical personnel.

Causative organisms

Organism	Percentage reported
Gram-positive cocci	52 – 85 %
Staphylococcus aureus	22 – 60 %
Staphylococcus epidemics	9 – 13 %
Meticillin-resistant Staphylococcus aureus	6 – 29%
Enterococcus faecalis	2 – 18 %
Gram-negative bacilli	20 – 28 %
Pseudomonas aeruginosa	2 – 15 %
Enterobacter cloacae	9 %
Escherichia coli	10 %
Acinetobacter species	13 %
Serratia marcescens	1 – 2 %
Klebsiella pneumonia	6 %
Polymicrobial	16- 20 %
Acid-fast organisms	Rare
Fungi	Rarely reported

Types of HD catheter infection

- Localized exit site infection.
- Tunnel infection.
- Systemic infection.
- Last access cuffed tunneled infected catheter.

Vascular access infection definitions

Exit site

Infection Site	KDOQI Vascular Access ⁶	CDC Guideline for Prevention of Device-Related Infection ^{6,7}	CDC Surveillance of Nosocomial Infections ⁶	Public Health Agency of Canada ⁹
Exit site	Inflammation confined to the area surrounding the catheter exit site, not extending superiorly beyond the cuff if the catheter is tunneled, with exudate culture confirmed positive	Erythema, tenderness, induration, or purulence within 2 cm of the skin at the exit site of the catheter	Not defined	<p>Definite: Purulent discharge or erythema, tenderness, or induration (2 of 3) at exit site with positive culture result of serous discharge</p> <p>Probable: Erythema, tenderness, or induration (2 of 3) at exit site without a positive culture result of serous discharge <u>(if no discharge, lack of alternative explanation)</u></p> <p>Possible: Erythema, tenderness, or induration (2 of 3) at exit site, but <u>alternative cause cannot be ruled out</u></p>

Vascular access infection definitions

Tunnel

Infection Site	KDOQI Vascular Access ⁶	CDC Guideline for Prevention of Device-Related Infection ^{6,7}	CDC Surveillance of Nosocomial Infections ⁶	Public Health Agency of Canada ⁹
Tunnel	Catheter tunnel superior to the cuff is inflamed, painful, and may have drainage through the exit site that is culture positive	Erythema, tenderness, and induration in tissues overlying the catheter and >2 cm from the exit site	Not defined	<p>Definite: purulent discharge from tunnel or erythema, tenderness, or induration (2 of 3) at tunnel with a positive culture result of serous discharge</p> <p>Probable: Erythema, tenderness, or induration (2 of 3) at tunnel with serous discharge without a positive culture result <u>(do not need discharge if no alternative explanation)</u></p> <p>Possible: erythema, tenderness, or induration (2 of 3) at tunnel, but <u>alternative cause cannot be ruled out</u></p>

Vascular access infection definitions

Bloodstream

Infection Site	KDOQI Vascular Access ⁶	CDC Guideline for Prevention of Device-Related Infection ^{6,7}	CDC Surveillance of Nosocomial Infections ⁶
Bloodstream	Blood culture results positive for the presence of bacteria with or without the accompanying symptom of fever	<div>Definite: same organism from a semiquantitative culture of the catheter tip (>15 colony-forming units/catheter segment) and from a blood culture in a symptomatic patient with no apparent other source of infection</div> <div>Probable: defervescence of symptoms after antibiotic therapy with or without removal of the catheter, in the setting in which blood cultures confirm infection, but catheter tip does not (or catheter tip does but blood does not) in a symptomatic patient with no other apparent source of infection</div>	Patient has a recognized pathogen cultured from ≥ 1 blood culture that is not related to an infection at another site or Fever ($>38^{\circ}\text{C}$), chills, or hypotension (at least 1 of 3) and common skin contaminant (diphtheroids, <i>Bacillus</i> or <i>Propionibacterium</i> species, coagulase-negative staphylococci, or micrococci) cultured from ≥ 2 blood cultures drawn on separate occasions (only 1 is necessary if appropriate antimicrobial therapy is instituted) and are not related to an infection at another site

Rate of hemodialysis catheter infection

Rate of uncuffed cath. infection:

- 8% by 2wks.
- 25% by 1 month.
- 50% by 2 months.
- Catheter related septicemia is 2 -20%.

Agarwal, Anil K, Asif Arif. NephSAP. Interventional Nephrology, ASN. 361-375. 2009.

- Cuffed rate 1.6-5.5/1000 d.
- Non cuffed 3.8-6.6/1000 d.

Beathard GA, Urbanes A: Infection associated with tunneled hemodialysis catheters. Semin dial 21: 528-538, 2008.

Predisposing factors

Host- related factors

- Impaired host immunity
- Poor personal hygiene
- Occlusive dressing
- S. aureus nasal carriage
- Older age
- Diabetes mellitus
- Recent hospitalization
- High cumulative dose of intravenous iron

Pathogen related factors

- Biofilm formation
- Resistance to antibiotic therapy
- Bacterial virulence
- S. aureus nasal carriage
- Contiguous infection

Catheter related factors

- Site of insertion
- Increased duration of catheter use
- History of bacteremia
- Colonization of catheter tip and cutaneous tract with skin flora
- Catheter lumen contamination
- Hematogenous seeding of the catheter from another infectious source
- Contamination of the lumen with infusate
- Lack of aseptic precautions during catheter insertion

Hemodialysis procedure-related factors

- Contamination of dialysate or equipment
- Inadequate water treatment
- Dialyzer reuse



Hemodialysis Catheter infection complications

- Serious complications, including infective endocarditis, septic arthritis, septic emboli, osteomyelitis, epidural abscess and severe sepsis, have been reported.
- *S. aureus* has been predominantly isolated from those patients as a result of the predilection of *S. aureus* for heart valves and bone

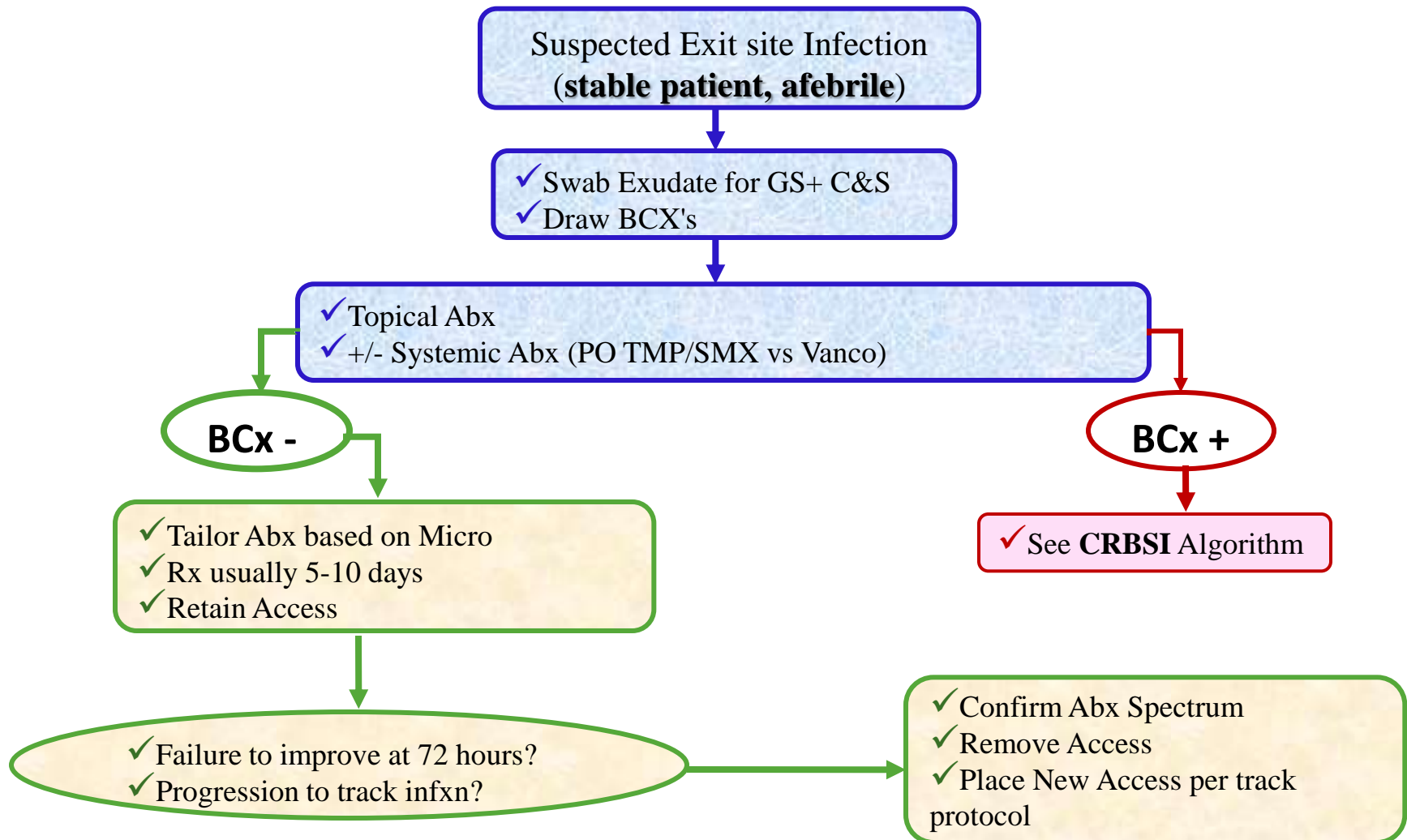
Investigations for catheter infection

- CBC.
- Blood Culture peripheral and from catheter.
- Catheter tip Cx.
- Exit site discharge.
- Others: Urine, Sputum, Drains..etc.

Exit site infection

- Erythema, discharge and tenderness.
- Obtain Cx.
- Could be treated with Local and oral AB.
- Rarely required removing the catheter.

Algorithm for Suspected Exit Site Infections



ESNT Vascular Access Guidelines



Guideline 5.3 – Minimizing the risk of catheter related infection

- We recommend that the catheter exit site should be cleaned with Chlorhexidine 2%. (1B)

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ESNT Vascular Access Guidelines



We recommend application of either topical agents or intraluminal lock solutions for the reduction of exit-site infection and catheter-related bacteraemia. Options of topical agents include mupirocin 2% ointment and polysporin. Intraluminal lock agents include both antibiotic based and non-antibiotic-based solutions. Ideal antibiotics and optimal doses are yet to be defined. (Level 1 evidence)

Electronic Nephrology Education: ESNT Virtual Academy

Catheter Tunnel infection

- Inflammatory signs over the tunnel.
- Purulent discharge.
- IV AB.
- Exchange of the catheter.
- Different site.

Algorithm for Suspected Track Infections

Suspected Tunnel Infection
(**stable patient, afebrile**)

- ✓ Swab Exudate for GS+ C&S
- ✓ Draw BCX's
- ✓ Remove Line ASAP (<24hours)
- ✓ Establish PIV(not PICC if possible)

IV Vanco + [tobra or ceftaz]

BCx -

- ✓ Tailor Abx based on Micro
- ✓ Rx usually 5-10 days

Ideal criteria for new access?

- ✓ 48 hours appropriate abx
- ✓ 48 hours BCx-negative
- ✓ Non-infected track tissue available

BCx +

- ✓ See CRBSI Algorithm

Catheter related Bacteremia

Clinical picture:

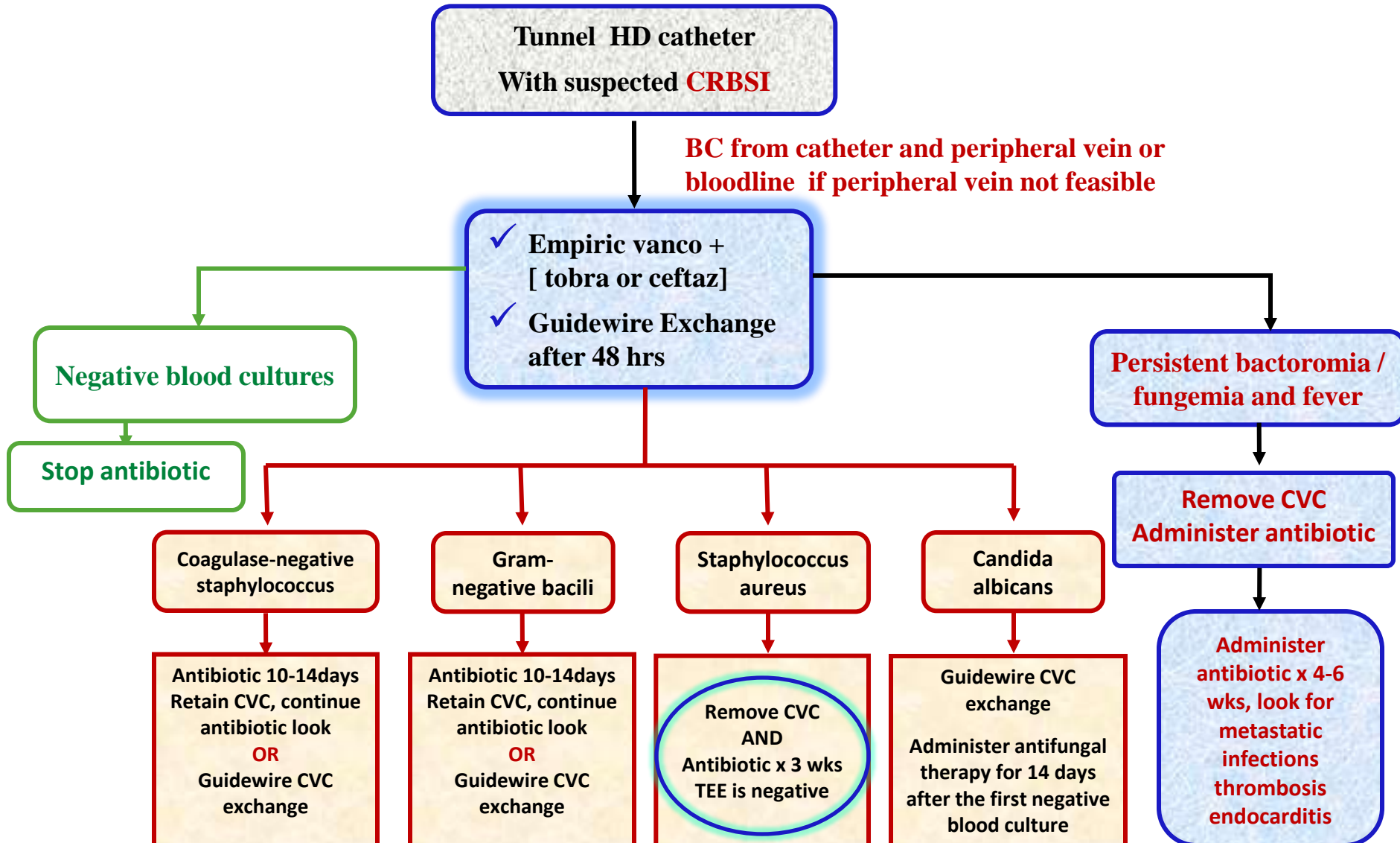
- Fever with chills.
- May be only during HD.
- patient with Central catheter.
- No other focus.
- Sepsis.

Dx: Blood Cx > 15CFU. From peripheral and catheter

Treatment AB for 2-3 wks with exchange of the catheter

• The catheter is the cause of fever unless proven otherwise

Algorithm for Suspected catheter related bacteremia (CRBSI)



Management of central venous catheter infection related bacteremia

Hemodialysis Catheter-related bacteremia suspected

Draw blood cultures and start empiric broad-spectrum antibiotics

Mild symptoms plus normal exit site and tunnel

Exchange over guide wire within 48h of antibiotic initiation and defervescence

Mild symptoms plus infected exit site

Remove catheter and place at new site OR exchange over guidewire with creation of new tunnel

Mild symptoms plus infected tunnel

Remove catheter and place at new site within 48h of antibiotic initiation and defervescence

Severe symptoms

Remove catheter with delayed replacement after defervescence or negative surveillance blood cultures

Treat with antibiotics guided by speciation and sensitivities organism for at least 3 weeks

Indications for catheter removal

- Unstable patients
- Bacteremia with tunnel involvement
- Metastatic infection.

ESNT Vascular Access Guidelines



Guideline 6.1 – Treatment of access infection and related bacteremia

- We recommend that venous catheters should be removed in all seriously ill hemodialysis patients with catheter related bacteremia unless no alternative vascular access can be achieved. (1B)

Electronic Nephrology Education: ESNT Virtual Academy

Criteria to attempt catheter salvage

- Difficult to replace catheters
 - A hemodynamically stable patient
 - Blood sterile in 48–72 h
 - No sign of tunnel infection
 - No signs of metastatic infection
 - Microorganisms medically treatable
-
- There is a 5-fold higher risk of treatment failure when TCC salvage is attempted, and an 8-fold higher risk in cases associated with *S. aureus bacteraemia*
 - **Salvage should be used only as a treatment of last resort**

Catheter Salvage in poor access

30% AB treatment could clear infection.

80% AB with exchange over guide wire.

Tanriover B, Carlton D, Saddekni S, Hamrick K, Oser R, Westfall AO, Allon M: Bacteremia associated with tunneled dialysis catheters: Comparison of two treatment strategies. Kidney Int 57: 2151–2155, 2000

Exchange:

- 72 hours post AB.
- No need for negative blood Cx.

National Kidney Foundation: KDOQI clinical practice guidelines and clinical practice recommendations for vascular access 2006. Am J Kidney Dis 48[Suppl 1]: S176–S322, 2006

Antibiotic Lock

- Is indicated in reinfection with same organism.
- In limited catheter sites.
- Catheter Salvage is acceptable.

Onder AM, Chandar J, Simon N, Diaz R, Nwobi O, Abitbol CL, Zilleruelo G:
Nephrol Dial Transplant 23: 2604–2610, 2008.

ESNT Vascular Access Guidelines



Guideline 5.4 – Minimizing the risk of catheter related infection

- We suggest that an antimicrobial or antibiotic lock solution be used to reduce catheter related bacteremia and other infections. (2B)

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Types of Antibiotic Lock

- Cefazolin, Cephalexin, Vancomycin, Tobramycin, Gentamicin.

Concentration: 5mg/ml.

mixed with Citrate, EDTA, Heparin, rtPA. .

Systemic AB with Antibiotic lock more effective for

- G. Neg.
- Less effective for Staph. Epidermidis.
- Worst for Staph aureus.

Maya ID, Carlton D, Estrada E, Allon M: Treatment of dialysis catheter-related Staphylococcus aureus bacteremia with antibiotic lock: A quality improvement report. Am J Kidney Dis 50: 289–295,2007

Conclusion

- Strict follow up of infection control policy in insertion and manipulations of dialysis catheters .
- Update the National guidelines
- Dialysis Access Care program
- More efforts in Patient education
- AVF First

